

Dedy DARNAEDI^{*,**}, Masahiro KATO^{*} & Kunio IWATSUKI^{*}:

**Five new or ill-defined species related to
Dryopteris sparsa (Dryopteridaceae)**

デディ ダルナエディ^{*,**}・加藤雅啓^{*}・岩槻邦男^{*}:

ナガバノイタチンダ (オンダ科) の5近縁種

(Pl. VII-VIII)

Dryopteris sparsa (Ham. ex D. Don) O. Kuntze and species related to it comprise *Dryopteris* sect. *Nephrocystis* (Ito 1939, Serizawa 1976, Fraser-Jenkins 1986). As some closely related species of the section are recognizable by only small morphological differences, the delimitation of the species, particularly Taiwanese species, has differed according to the author. Fraser-Jenkins' (1986, 1989) circumscription differs considerably from most current classifications (e.g., Nakaike 1975, Serizawa 1976). While separating *D. viridescens* (Bak.) O. Kuntze from *D. sparsa*, he united *D. melanocarpa* Hayata with *D. platypus* O. Kuntze, and *D. yakusilvicola* Kurata with *D. caccina* Tagawa. Kurata (1962), Nakaike (1975), Serizawa (1976) and others reported the occurrence of *D. melanocarpa* in Japan, but Darnaedi & Iwatsuki (1987) considered Yakushima plants previously identified as *D. melanocarpa* as belonging to *D. yakusilvicola*. DeVol & Kuo (1975) included *D. melanocarpa* in *D. sparsa*, but they did not treat some other species related to *D. sparsa*. Therefore we realized that a more detailed study was needed for a better taxonomic treatment of *D. sparsa* and its closely related species in Taiwan. During recent field work, Kato (1986) and Mitsuta (1986) found unnamed species closely related to *D. sparsa* in Seram Island (the Moluccas) and Thailand, respectively.

The *D. sparsa* complex awaits extensive taxonomic revision based on materials throughout the distribution range of it. In this paper we describe three new species, two from Seram Island and one from Thailand, and also we recognize *D. caccina* and *D. melanocarpa* as distinct species.

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Materials and methods Species circumscription was made on the basis of comparative morphological observations using herbarium specimens represented at BM, BO, K, KUN, KYO, PE, TI, and TNS, which were collected in various places of East and Southeast Asia in the distribution range of the *D. sparsa* complex, in addition to our recent collections.

Among the characters examined, pinnule arrangement was recorded following Serizawa's (1976) method. The arrangement (AP) of a pair of basal pinnules is quantitatively presented by $AP = \log_{10} a/b$, in which *a* and *b* are the distance between acroscopic and basiscopic basal pinnules and pinna base, respectively. To determine the variation in pinnule arrangement, mean values of the APs of all pinnae except for the basal and uppermost pinnae in each individual were used, because an anadromous pinnule arrangement in those parts is constant in the *D. sparsa* complex, whereas the pinnule arrangement of the other (middle) pinnae seems useful for defining interspecific differences. A scatter diagram showing variation in the mean AP values and the length ratio of basal pinna to basiscopic basal pinnule is presented in Fig. 1.

For scanning electron microscopy (SEM), untreated spores were coated

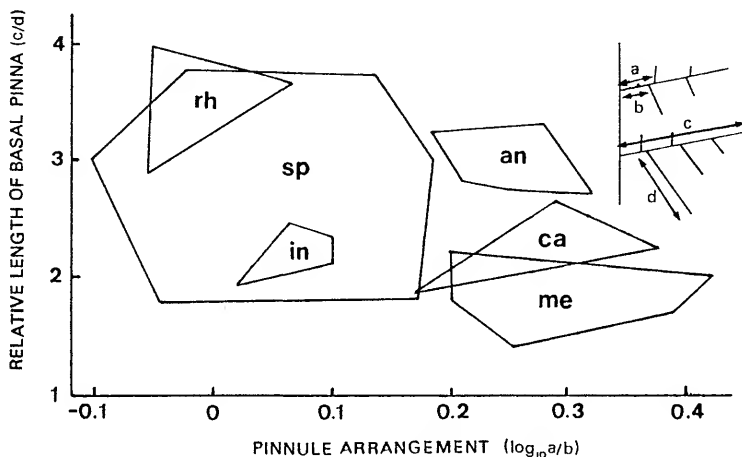


Fig. 1. A scatter diagram showing variations in relative length of basal pinnae (*c/d*) and pinnule arrangement (mean AP). an, *D. angustipalea*; ca, *D. cacaina*; in, *D. indonesiana*; me, *D. melanocarpa*; rh, *D. rheophila*; sp, *D. sparsa*; a, distance between costa base and basal acroscopic pinnule; b, distance between costa base and basal basiscopic pinnule; c, length of basal pinna; d, length of basal basiscopic pinnule.

with gold and observed under a JOEL JSM-820S scanning electron microscope. Spore size was measured in 200 spores per specimen and one to several specimens were examined for each species.

Description of species Even though in this study we recognize five species closely related to *D. sparsa*, the latter is still a polymorphic species complex. Fraser-Jenkins (1986, 1989) treated Chinese and Japanese plants as *D. viridescens*, separating them from the Himalayan *D. sparsa*. Darnaedi et al. (1989) showed that *D. sparsa* is polymorphic in cytology and reproductive mode as well as morphological characters. A further biosystematic study is needed for elaboration of the complex.

Descriptions of chromosome numbers and reproductive modes of the *D. sparsa* complex follow (Darnaedi et al. 1989).

Key to the species

1. Leaves bipinnate or shallowly tripinnatifid, costae inserted at narrow angles (<50°) to rachis; facultative rheophyte 1. *D. rheophila*
1. Leaves tripinnatifid to tripinnate, costae inserted at wider angles; geophyte.
 2. Sori costular, scales broadly ovate.
 3. Lamina up to 56 cm long, tripinnate, middle pinnae more than 7 cm broad, pinnules subopposite or catadromous, subacute at the apex 2. *D. indonesiana*
 3. Lamina less than 30 cm long, tripinnatifid, middle pinnae less than 5 cm broad, pinnules distinctly catadromous, rounded at the apex 3. *D. cacaína*
 2. Sori inframedial to supramedial, if sori subcostular, scales linear- to oblong-lanceolate.
 3. Lamina deltoid or pentagonal in outline, basal pinnae abruptly broadened toward the base, pinnules of middle pinnae distinctly catadromous 4. *D. melanocarpha*
 3. Lamina ovate-deltoid, basal pinnae gradually broadened toward the base, pinnules of middle pinnae subopposite or catadromous.
 4. Scales at stipe base linear- to oblong-lanceolate, leaves at most medium-sized but deeply tripinnatifid, pinnules of middle pinnae distinctly catadromous, sori inframedial, 1 mm in diam. 5. *D. angustipalea*
 4. Scales at stipe base broadly lanceolate to ovate, leaves medium-sized, usually not deeply tripinnatifid, pinnules of middle pinnae subopposite or

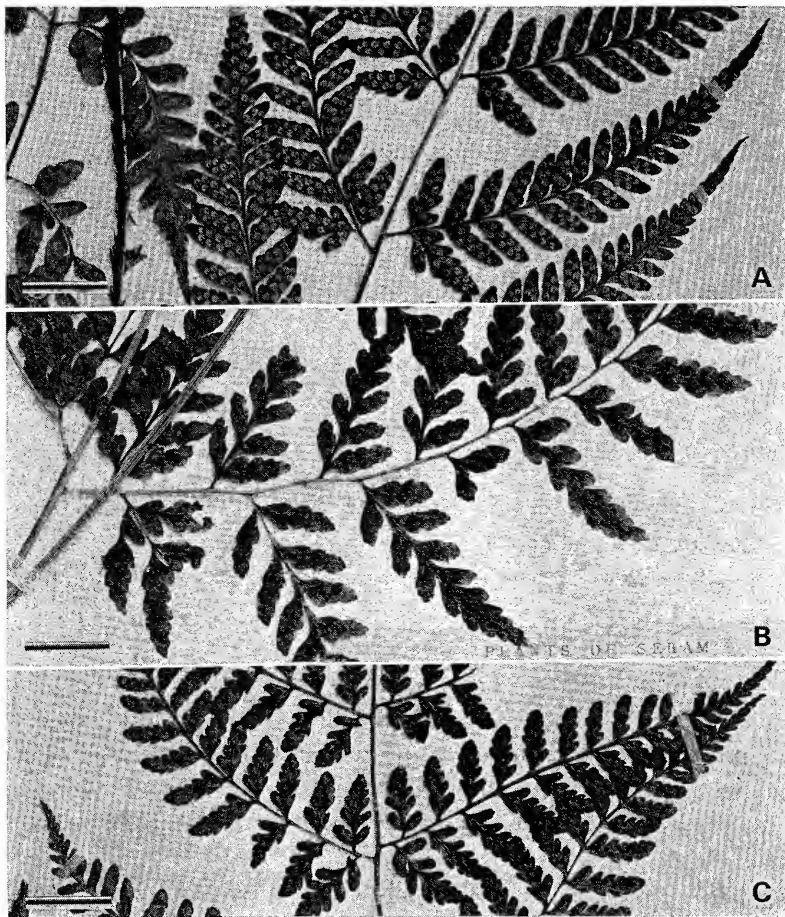


Fig. 2. Parts of pinnae and pinnules of *D. rheophila*, Yahara TY-521 (A), *D. indonesiana*, Kato et al. C-5371 (B), and *D. angustipalea*, Kato et al. C-11616 (C). Bar=2 cm.

catadromous, sori medial or supramedial, up to 2 mm in diam.
 6. *D. sparsa*

1) ***Dryopteris rheophila*** Mitsuta, sp. nov. Fig. 2A, Pl. VIIA, B.

Affinis *D. sparsae* (Ham. ex D. Don) O. Kuntze sed stipite lamina brevior, squamis persistentibus, lamina in vivo atroviridi, bipinnata vel leviter tripin-

natifida, pinnis obliquis, et pinnulis haud imbricatis differt.

Rhizomes erect; scales at rhizome apices and the lower 2/3 of stipes persistent, thin, dull brown, ovate, up to 7×4 mm, gradually smaller and sparse at the upper part of stipes; stipes 10–40 cm long; lamina oblong-lanceolate to narrowly deltoid-ovate, more or less abruptly narrowed to the long acuminate apex, bipinnate to shallowly tripinnatifid, $17\text{--}43 \times 7\text{--}18$ cm, when living dark green; pinnae 8–16 pairs, inserted at narrow angles (less than 50°), basal or subbasal pinnae longest, narrowly deltoid, up to 13×5 cm, middle pinnae $5\text{--}11 \times 2\text{--}3$ cm, oblong, broadest at the base, acuminate toward the apex; pinnules subopposite at the base of middle pinnae, oblong, unequally cuneate at the base, obtuse at the apex, shallowly lobed, each lobe with one short sharp tooth; rachis and costae usually glabrous; sori medial on acroscopic veinlets, distributed throughout lamina; indusia round-reniform, up to 2 mm in diam., brown, persistent, rather thick in central part with membranous margin; spores ellipsoid, $35.8\text{--}52.3 \mu\text{m}$ (mean $44.0 \mu\text{m}$) long; perispore in SEM view convolute with reticulate secondary ornamentation; chromosome number $n=82$, $2n=164$ (tetraploid); reproduction sexual.

Type. Thailand. Northeast. Prov. Loei: Phu Kradung, ca. 1300 m, on river bank, T. Yahara TY. 48Z¹⁾ (TI, duplicates BO, KYO, L).

Habitat. Facultative rheophyte; on sandstone boulders in streambed or terrestrial in montane forest.

Distribution. Endemic to Northeastern Thailand.

Specimens examined. Thailand. Northeast. Udawn, Phu (Mt.) Kradung, Pen Pop Mai Waterfall, ca. 1160 m, on sandstone boulders, Hennipman 3669 (KYO); Prov. Loei, Phu Kradung, ca. 1300 m, Yahara TY. 48A (TI), TY. 48X (TI), TY. 49Y (TI), TY. 52 (TI), TY. 52A (TI), TY. 52I (TI), TY. 52X (TI), TY. 52Y (TI), TY. 52Z (TI), Mitsuta et al. T-42228 (KYO); Phu Keio, terrestrial in montane forest, Yahara TY. 49D (TI), TY. 49X (TI).

Note. Although *D. rheophila* shows morphological features characteristic of rheophytes, particularly narrow and narrowly inserted pinnae and pinnules, it is distinguishable from *D. sparsa* only by a combination of characters. The

1) This and subsequently recorded TY numbers are specimens taken from living plants cultivated in the Botanical Gardens, University of Tokyo, which were originally collected from the followed localities.

sterility of their hybrid, *D. sparsa* × *D. rheophila*, suggests that *D. rheophila* is distinct enough to warrant species recognition (Darnaedi et al. 1989).

Dryopteris rheophila Mitsuta × *D. sparsa* (Ham. ex D. Don) O. Kuntze
Thailand. Northeast. Prov. Loei, Phu (Mt.) Kradung, ca 1300 m, Yahara
TY. 50B (TI), TY. 54L (TI).

Habitat. On river bank.

Note. This hybrid is hardly distinguishable from *D. sparsa*, from which it differs only in having more persistent scales on stipes. The evidence for hybridity is presented by Darnaedi et al. (1989).

2) ***Dryopteris indonesiana***, sp. nov. Fig. 2B, Pl. VIIC, D.

A *D. sparsa* (Ham. ex D. Don) O. Kuntze foliis amplis, tripinnatis, soris costulis approximatis differt.

Rhizomes erect; stipes 30–60 cm long, scales at the base ovate, 5 × 4 mm, deciduous; lamina broadly ovate, acuminate at the apex, 32–56 × 24–41 cm, tripinnate; pinnae 7–14 pairs, basal or subbasal pinnae longest, up to 21 × 12 cm, basal pinnae deltoid with basal basisopic pinnules up to 10 cm long, middle pinnae deltoid-oblong, up to 18 × 9 cm; pinnules subopposite to catadromous, narrowly deltoid, subacute at the bluntly pointed apex, cuneate at the base, up to 5 × 2 cm; pinnule-segments shallowly lobed, each lobe with one very short blunt tooth; rachis and costae glabrous; sori near midveins on acroscopic veinlets, single or double; receptacles comma-shaped, in double sori distinctly raised; indusia round-reniform, up to 2 mm in diam., persistent, thick in central part with membranous margin; spores ellipsoid, 33.0–49.5 μm (mean 41.8 μm) long; perispore in SEM view lophate with granulate secondary ornamentation; reproduction sexual.

Type. Indonesia. Central Seram. Manusela National Park: between Goa (Cave) Pohon Damar and the W foot of Gunung (Mt.) Roihelu, south of Sawai, Kecamatan (District) Seram Utara, 1060–1130 m, limestone area, lower montane forest in ravine, terrestrial on river bank, Kato et al. C-5371 (TI, duplicate BO).

Habitat. Terrestrial in evergreen montane forest.

Distribution. Indonesia (Seram, Java, Sumatra).

Specimens examined. Sumatra. Aceh: middle elevation of Gunung Kemiri, 1600–1800 m, in dense evergreen forest, terrestrial on humus rich ground along path at ridge, Iwatsuki et al. S-990 (KYO). Java. Preanger: Kawah Kamo-djang, 1700 m, Popta 120 (BO).

Note. This species differs from *D. sparsa* and its related species by its large leaves, costular sori with often raised receptacles, and lophate perispores with granulate secondary ornamentation. The species is known in a few scattered localities in Indonesia.

Spore size seems to be correlated with ploidy level in the *D. sparsa* complex [29.8–41.3 μm (mean 34.9 μm) long in a diploid race of *D. sparsa*, and 33.8–48.0 μm (42.0 μm) long in a tetraploid race of *D. sparsa*; see also descriptions of the other species]. This may indicate that *D. indonesiana* is tetraploid.

3) ***Dryopteris cacaina*** Tagawa, Acta Phytotax. Geobot. 6: 155, 1937. Type. Taiwan. Prov. Tainan: inter Numanohira et Takata (Mt. Arisan), Tagawa 397 (KYO). Pl. VIIIE, F.

Stipes 15–27 cm long, purple-brown at the base, chestnut-brown, subpolished above, sparsely scaly except at the upper part; scales broadly ovate, brown, up to 5×3 mm; lamina ovate, more or less abruptly narrowed toward the acuminate apex, 20–30×10–15 cm, tripinnatifid, firm-herbaceous; pinnae 6–8 pairs, basal pinnae longest, up to 15 cm long, deltoid, more or less gradually broadened toward the base, with basal basispic pinnules the longest (up to 7 cm long), middle pinnae narrowly deltoid, acuminate at the apex, broadest at the base, up to 6–10×2.5–4.0 cm (5.0 cm at the base); pinnules of middle pinnae oblong-deltoid, rounded at the apex, truncate at the acroscopic and cuneate at the basispic base, 2×1 cm, lobed halfway to costule (basal pinnules deeply lobed); pinnule-segments oblong, up to 4 mm broad, obtuse, toothed at edge; rachis and costae chestnut-brown or brown, subpolished, glabrous; sori costular or subcostular; indusia round-reniform, up to 1.5 mm in diam., glandular on the surface, thick and dark brown in central part, membranous and brown at margin; spores ellipsoid, 30.0–42.5 μm (mean 36.6 μm) long; perispore in SEM view convolute; reproduction sexual.

Distribution. Taiwan.

Specimens examined. Taiwan. Prov. Taichu: inter Hattukwan et Tonpo, Tagawa 472 (KYO); between Hattukwan and Rakuraku, Ohwi 3877 (KYO). Prov. Kwareenko: inter Sekigahara et Gokwan, Tagawa 814 (KYO, TI).

Note. This species differs from *D. sparsa* and *D. melanocarpa* in its rounded pinnules and costular sori, and from the latter also in its ovate lamina with basispic basal pinnules of basal pinnae not being much longer than subbasal pinnules. Tagawa (1937) noted "This is growing in high mountainous regions

where *D. sparsa* is not found," as also is characteristic of *D. melanocarpa*. *Dryopteris cacaia* is similar to *D. indonesiana* in its costular sori, but it differs from the latter in its much smaller leaves and catadromous pinnules with rounded apices (Fig. 1).

4) ***Dryopteris melanocarpa*** Hayata, Icon. Pl. Formos. 4: 163, f. 104, 1914; C. Chr., Ind. Fil. Suppl. 2: 14, 1917; T. Ito, Zoku Taiwan Shokubutu Zusetu t. 107, 1928; Ogata, Icon. Fil. Jap. 6: pl. 269, 1935; H. Ito in Nakai & Honda, Nova Fl. Jap. 4: 30, 1939; Fil. Jap. III, pl. 232, 1944; Namekata & Kurata, Enum. Jap. Pterid. 301, 1961, p.p. ex pl. Jap.; Kurata, J. Geobot. 10: 99, 1962, p.p.; Sugimoto, Keys Herb. Pl. Jap. Pterid. 274, 1966, p.p.; Momose, Prothallia Jap. Ferns (Fil.) 291, 1967, p.p.; Hirabayashi, Cytogeogr. Stud. *Dryopteris* Jap. 136, 1974, p.p.; Nakaike, Enum. Pterid. Jap. 224, 1975, p.p. Type. Taiwan. Arisan, Hayata s.n. 1912 (TI). Pl. VIII A, B.

Dryopteris subtripinnata (Miq.) O. Kuntze var. *bunkikiyensis* Rosenst., Hedwigia 56: 342, 1915. Type. Taiwan. Bunkikiyo, 2000 m, Faurie 393 (isotype KYO, TI).

Dryopteris sparsa (Ham. ex D. Don) O. Kuntze; DeVol & Kuo, Fl. Taiwan 1: 380, 1975, p.p. non O. Kuntze & auctt.

Dryopteris platypus O. Kuntze; Fraser-Jenkins, Bull. Brit. Mus. (Nat. Hist.) 14: 210, 1986, p.p. non O. Kuntze.

Rhizomes erect; scales at rhizome apices and the lower half of stipes persistent, thin, dull-brown, ovate-lanceolate, up to 7×4 mm, gradually smaller and sparse at the upper part of stipes; stipes 18–36 cm long, longer than lamina; lamina deltoid or pentagonal, abruptly narrowed to the acuminate apex, tripinnatifid to tripinnate, 14–33 cm long, 16–30 cm broad; pinnae 7–12 pairs, basal pinnae longest, deltoid, up to 17 cm long, with basal basiscopic pinnules longest, up to 9 cm long; middle pinnae narrowly deltoid-oblong, caudate at the apex, $10-16 \times 4-6$ cm; pinnules of middle pinnae distinctly catadromous, narrowly deltoid-oblong, subacute at the apex, $1-3 \times 0.5-1.0$ cm; pinnule-segments shallowly lobed, each lobe with one short tooth at edge; sori medial on acroscopic veinlets; indusia round-reniform, up to 1.5 mm wide, persistent, brown, rarely dark brown; spores ellipsoid, $30.3-40.3 \mu\text{m}$ (mean $34.5 \mu\text{m}$) long; perispore in SEM view convolute with reticulate secondary ornamentation; chromosome number $n=41$, $2n=82$ (diploid); rarely $2n=123$ (triploid); reproduction sexual, rarely agamosporous.

Habitat. Terrestrial in evergreen montane forest.

Distribution. Taiwan.

Specimens examined. Taiwan. Chiayi, Fenchihu, Kuo 1625 (KYO); Mt. Alishan, near Fenchihu station along Alishan railroad, ca. 1500 m, Suzuki et al. TH&SP-1 (TI), TH&SP-2 (TI), TH&SP-6 (TI), Taiwan-2 (TI); Mt. Alishan, Chunshan—Alishan station, 2150–2450 m, Suzuki et al. TH&SP-12 (TI), TH&SP-13 (TI), TH&SP-14 (TI), TH&SP-15 (TI); Mt. Alishan, Shizulu—Erhwanping—Alishan station, Suzuki et al. TH&SP-8 (TI); Mt. Alishan, Alishan station—Shenmu, ca. 2200 m, Suzuki et al. TH&SP-5 (TI), TH&SP-7 (TI); Mt. Alishan, Nakazawa 15955 (TI), Hayata s.n. 1912 (TI), Inada 21 (TI), Sato 162 (TI), Faurie 524 (KYO); Wu-feng-xiang, Mt. Alishan—Mt. Zhushan, 2200–2300 m, Murata et al. JM&TK-1 (TI), JM&TK-2 (TI), JM&TK-5 (TI), JM&TK-7 (TI), JM&TK-8 (TI), JM&TK-9 (TI), JM&TK-10 (TI), JM&TK-12 (TI), JM&TK-13 (TI); Mt. Alishan—Mt. Shushan, Ohwi 3528 (KYO), 3551 (KYO); Mt. Alishan, Sekizan—Tahtaka, Tatewaki s.n. 23 Mar. 1932 (KYO). Prov. Taito, Taito-gun, near Zyomoru, Tagawa 2722 (KYO); Kwanzan-gun, near Asahi, Tagawa 3105 (KYO, TI); Kwanzan-gun, between Kaimosu and Matenguru, Tagawa 2896 (KYO). Prov. Taichu, Chikuzan-gun, Ito s.n. 29 May 1936 (TI). Prov. Kwau-renko, Kwauren-gun, between Kirai and Higashinoko, Tagawa 3280 (KYO). Bunkikiyo, Faurie 393 (KYO, TI).

Note. Fraser-Jenkins (1986) treated *D. melanocarpa* as synonymous with *D. platypus* originally described from Java. Although the type specimen of *D. platypus* was not examined, in our field and herbarium work we did not find any Southeast Asian plants referable to *D. melanocarpa*.

Dryopteris melanocarpa was reduced to a synonym of *D. sparsa*, which coexists in Taiwan (DeVol & Kuo 1975), but it differs from the latter in its persistent scales, distinctly catadromous pinnules, and relatively longer basal basiscopic pinnules (Fig. 1). The species segregation is also supported by a preliminary enzyme electrophoretic study (Darnaedi 1989).

Serizawa (1971) described *D. melanocarpa* var. *elegans* from Yakushima Island. The type of the variety, Serizawa 7276 (TNS), belongs to *D. yakusil-vicola*. *Dryopteris melanocarpa* has been reported to occur in the main islands of Japan (Kurata 1962, Serizawa 1971, Nakaike 1975), but Japanese plants so named may be referable to an agamosporous race of *D. sparsa*, pending further study.

5) *Dryopteris angustipalea*, sp. nov. Fig. 2C, Pl. VIII, D.

A *D. sparsa* (Ham. ex D. Don) O. Kuntze et affinis squamis lineari- vel oblongi-lanceolatis, foliis tenuioribus, pinnulis parvioribus, indusiis in sicco rufobrunneis differt.

Rhizomes ascending to erect, up to 10 cm tall, scales at rhizome apices and the lower 2/3 of stipes thin, pale brown, persistent, linear- or oblong-lanceolate, up to 9×3 mm, gradually more sparse and smaller toward the upper part of stipes; stipes 17–29 cm long; lamina ovate-deltoid, acuminate at the apex, 16–32 × 14–24 cm, tripinnatifid to tripinnate; pinnae 10–14 pairs, basal pinnae longest, up to 12 cm long, with basiscopic basal pinnules longest, up to 4.5 cm long, middle pinnae narrowly deltoid-oblong, acuminate at the apex, 11×3.5 cm, with basal basiscopic pinnules shorter than the acroscopic, pinnules of middle pinnae distinctly catadromous, oblong, subacute or obtuse at the apex, usually shallowly lobed; pinnule-lobes oblong, up to 2.5 mm long, lobe with one short sharp tooth; rachis and costae glabrous; sori usually one in each lobe, inframedial on acroscopic veinlets; indusia round-reniform, 1 mm in diam., firm, reddish brown when dried, persistent; spores ellipsoid, 29.6–36.3 μm (mean 33.2 μm) long; perispore in SEM view convolute with reticulate secondary ornamentation; chromosome number $n=41$, $2n=82$ (diploid); reproduction sexual.

Type. Indonesia. Central Seram. Manusela National Park: along a trail between Wolu and Batu (Mt.) Kokan, southern slope of Murkele Ridge, Kecamatan (District) Tehoru, 380–1030 m, terrestrial in lower montane forest, Kato et al. C-6851 (TI, duplicates BO, K, KYO, L, MICH, MO).

Habitat. Terrestrial in evergreen montane forest.

Distribution. Seram Island, the Moluccas.

Specimens examined. Central Seram. Manusela National Park: along a trail between Gunung Eseli and Wae (River) Mamahala on the southern slope of Gunung Kobipoto, Kecamatan Seram Utara, 1000–1260 m, in montane oak forest, Kato et al. C-1761 (TI); along a trail between Wae Nua and G. Mapahue, southern slope of Murkele Ridge, near Saunulu, Kecamatan Tehoru, 150–880 m, on mossy ground in mossy forest, Kato et al. C-11611 (TI); along trail from Wae Niniyao to Wae Puo, south of Sawai, Kecamatan Seram Utara, 210–1020 m, limestone area, terrestrial on mountain ridge, Kato et al. C-5052 (TI). West Seram: along a trail between Tihulale to G. Totaniwel, Kecamatan Kairatu, 0–980 m, on mountain slope in montane forest, Kato et al. C-13650 (TI); along a trail

from Tanahgoyang to G. Sia Putti, Kecamatan Piru, 0-760 m, on wet mountain slope in deep shade, Kato et al. C-13212 (TI).

Note. This species differs from *D. sparsa* in having narrower (linear- to oblong-lanceolate) scales, distinctly catadromous arrangement of pinnules (Fig. 1), smaller pinnules, and small, reddish brown indusia. In Seram Island *D. angustipalea* occurs at lower elevations than *D. sparsa*. In its pinnule arrangement *D. angustipalea* resembles *D. melanocarpa*, from which it differs in its narrower scales, smaller pinnules, and relatively short basal basiscopic pinnules of the basal pinnae (Fig. 1).

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References

- Darnaedi, D. 1989. Systematic studies of *Dryopteris sparsa* complex (Dryopteridaceae). Thesis Dr. Sci. Univ. Tokyo. ——— & K. Iwatsuki 1987. On the structure and systematic position of the fern *Dryopteris yakusilvicola* Kurata. J. Fac. Sci. Univ. Tokyo III, 14: 121-136. ———, M. Kato & K. Iwatsuki 1989. A cytotaxonomic study of *Dryopteris sparsa* and closely related species (Dryopteridaceae). Journ. Jap. Bot. (in press). DeVol, C.E. & C.M. Kuo 1975. Dryopteridaceae. In H.L. Li et al. (eds.), Flora of Taiwan 1: 359-400. Epoch Publ. Co., Taipei. Fraser-Jenkins, C.R. 1986. A classification of the genus *Dryopteris* (Pteridophyta: Dryopteridaceae). Bull. Brit. Mus. (Nat. Hist.) 14: 183-218. ——— 1989. A monograph of *Dryopteris* (Pteridophyta: Dryopteridaceae) in the Indian subcontinent. Bull. Brit. Mus. (Nat. Hist.) 18: 323-477. Ito, H. 1939. Polypodiaceae—Dryopteroideae. In T. Nakai & M. Honda, Nova Fl. Jap. 4: 27-32. Kato, M. 1986. Taxonomic Studies of the Plants of Seram Island. Bot. Gard. Univ. Tokyo, Tokyo. Kurata, S. 1962. Notes on Japanese ferns (25). J. Geobot. (Kanazawa) 10: 97-101. Mitsuta, S. 1986. Pteridophyta. In H. Koyama (ed.), A preliminary check list of the

Pteridophytes and Dicotyledons of Phu Kradung in Thailand. Dept. Bot. Fac. Sci. Kyoto Univ., Kyoto. Nakaike, T. 1975. Enumeratio Pteridophytarum Japonicarum. Univ. Tokyo Press, Tokyo. Serizawa, S. 1971. Two varieties of Japanese ferns. J. Geobot. (Kanazawa) 19: 103-105. ————1976. A revision of the dryopteroid ferns in Japan and adjacent regions. Sci. Rep. Tokyo Kyoiku Daigaku B, 16: 109-148. Tagawa, M. 1937. Spicilegium pteridographiae Asiae orientalis 14. Acta Phytotax. Geobot. 6: 154-168.

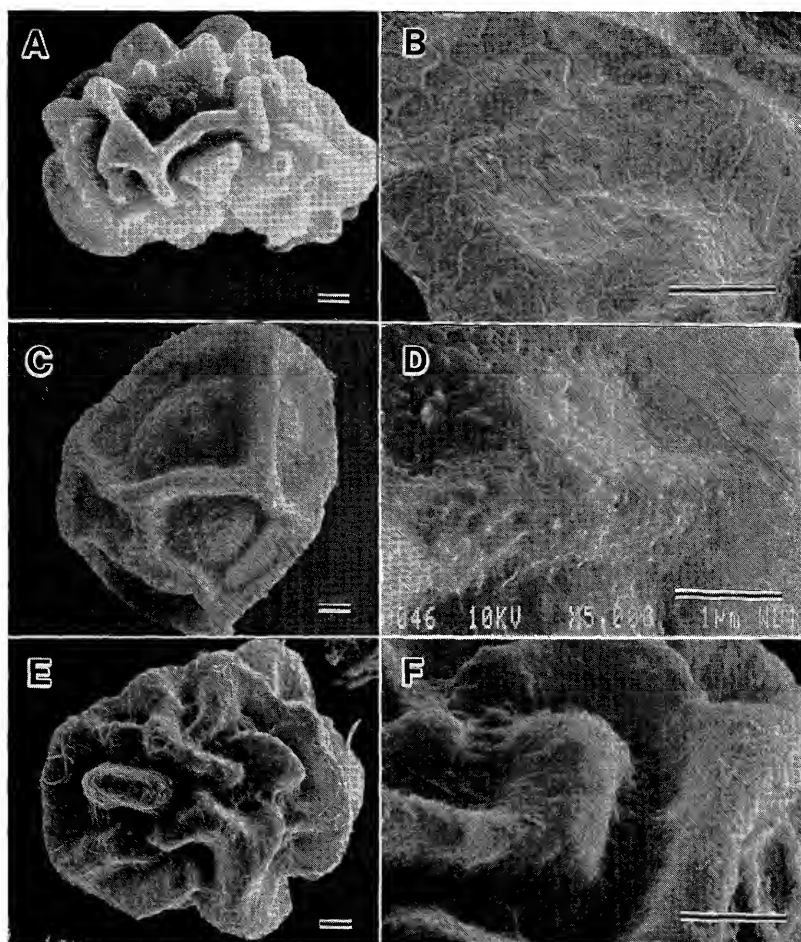
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ナガバノイタチシダは東アジアから東南アジア（西はヒマラヤ・スリランカ）にかけて広く分布する多型な種である。本稿ではこのシダに近縁な、3新種を含む5種を記載する。1) *D. rheophila* はタイ東北部に産する条件的溪流沿い植物であり、ナガバノイタチシダと不稔の雑種をつくる。本種をナガバノイタチシダと単独で区別する特徴的な形質はないが、葉の切れ込みが浅く2回羽状複葉で、羽片がかなり斜めにつき互に重なり合わないほど離れており、生時は濃い緑色であることなどいくつかの形質の組み合わせで区別できる。本種は光田重幸氏によって初めて認識された。2) *D. indonesiana* はセラム島（モルッカ諸島）、ジャワ、スマトラに稀に産する。大型のシダで3回羽状複葉、小羽片はほぼ対生かやや最下後側につき、ソーラスは中肋寄りにつきしばしば胞子嚢托は盛り上がる。大網目型の胞子も本種に特徴的である。3) *D. caccina*（ハウライイタチシダ）は台湾に分布するシダで、ソーラスが中肋寄りにつく点で前種に似るが、葉は比較的小型で、3回羽状深・中裂、小羽片は最下後側につき先端は丸い。4) クロミノイタチシダは最下羽片の最下後側の小羽片はその他に比べて著しく長いため葉形は5角形になる傾向があり、小羽片は最下後側につく、日本南部からも報告されているが今後の研究を要する。5) *D. angustipalea* はセラム島の固有種で、線形の鱗片、葉のサイズに比べて切れ込みが深い（3回羽状深裂）こと、小羽片が最下後側につくこと、ソーラスは直径1mmと小さく中間よりも中肋寄りにつくことが特徴である。これら5種を区別することによってナガバノイタチシダの実体がより明らかになったが、ヒマラヤから日本にかけてのナガバノイタチシダは形態的に多型で、しかも次報で示すように倍数体レベル、生殖様式の上でも多型であり、より詳細な分類学的研究が必要である。

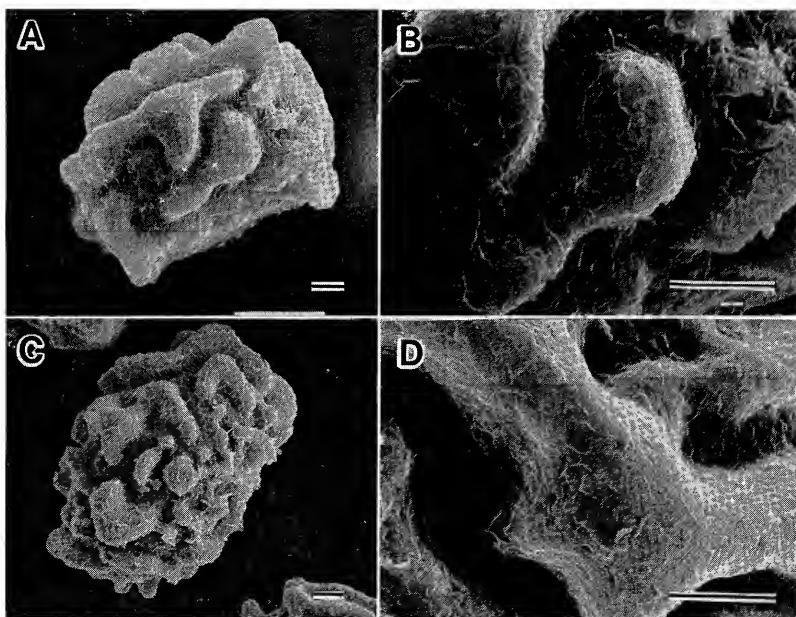
Explanation of plates VII and VIII

Pl. VII. SEM photographs of spores. A, B, *D. rheophila*. C, D, *D. indonesiana*. E, F, *D. caccina*. Bar=5 μ m.

Pl. VIII. SEM photographs of spores. A, B, *D. melanocarpha*. C, D, *D. angustipalea*. Bar=5 μ m.



DARNAEDI, KATO & IWATSUKI: Five *Dryopteris* (See p. 310)

DARNAEDI, KATO & IWATSUKI: Five *Dryopteris*